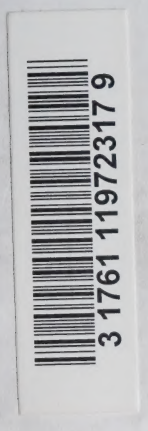

COMPOSITION OF FEEDING STUFFS ON THE CANADIAN MARKET - EVIDENCE OF FRANK T. SHUTT, M.A., CHEMIST TO THE DOMINION EXPERIMENTAL FARMS - 21ST AUGUST 1891

Canada. Agriculture and Colonization, Select Standing Committee on, 1891

HOUSE OF COMMONS OF CANADA.

EXAMINATION

OF

MR. F. T. SHUTT, M.A.

CHEMIST

TO THE

DOMINION EXPERIMENTAL FARMS,

BEFORE THE

SELECT STANDING COMMITTEE

ON

AGRICULTURE AND COLONIZATION,

21st August, 1891.

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HOUSE OF COMMONS,
COMMITTEE ROOM 46,
FRIDAY, 21st August, 1891.

The Committee met at 10.30, Mr. SPROULE presiding.

The Chairman introduced Mr. F. T. SHUTT, the Chemist to the Dominion Experimental Farms.

Mr. F. T. SHUTT.—Mr. Chairman and Gentlemen of the Select Committee on Agriculture: When on a previous occasion, I had the honour of addressing you concerning the work and objects of the chemical department of the Dominion Experimental Farms, I had entered upon my duties but a few months. Although a certain amount of analytical work had been accomplished, I contented myself rather at that time with outlining the work and the probable lines of investigation of my department in the immediate future. The laboratory was then occupying temporary quarters in the city, and our accommodation and apparatus were consequently very limited. It was chiefly on that account that I had not much chemical work to report. You will remember, however, that among the results which I referred to at that time were the analyses of some samples of Ladoga wheat. The chemical data obtained from the examination of many specimens of this wheat, grown in Russia, and in the various provinces of Canada, clearly prove the value of Ladoga wheat for our North-West Territories and Manitoba, and also showed that under the influence of the climate and fertile soil of these provinces the wheat had improved rather than deteriorated. These results and the deductions made therefrom are to be found *in extenso* in *Bulletin* No. 2 of the Farm Series.

Agricultural Laboratories.

I shall now, as concisely as clearness will allow me, endeavour to bring before you an outline of the work I have been enabled to do since that time, the work now in progress and the experiments which we propose to do in the future. First, let me briefly refer to the building of the permanent laboratories. I wish to speak on this subject for a moment, because it is a matter of importance, nay, rather, a *sine qua non*, for good and accurate work that there should be a well-equipped and convenient laboratory, with an ample supply of apparatus. Acting under instructions from the Honourable the Minister of Agriculture, I visited Germany, the home of agricultural science, and there inspected many agricultural laboratories in connection with the Government stations of that country. I looked into the character and methods of experimenting in agriculture there, and at the same time purchased apparatus for our own laboratories, by this means effecting, a very considerable saving in the cost of equipment. The observations I took on this tour are to be found somewhat in detail in the annual report of the Farms for 1888. On my return I drew up the plans for our laboratories, which have been erected under my personal supervision at the Central Experimental Farm. They afford us every facility for chemical work, and are withal tasteful in design, and I may add that although they are not the largest, they rank among the best-equipped and most convenient of all the chemical laboratories in the North American

continent. We expect them to meet for many years to come the ever-increasing requirements of the agricultural population of Canada.

It is not my intention to make this a chemical dissertation, nor can I hope to touch upon the many experiments and results of the past two years, but shall content myself with indicating the more important of these, and outlining the work for the future.

Analytical work accomplished.

I propose to classify the work I have to treat under four divisions, speaking very briefly on each of them. First of all, I shall say a few words soils; secondly, on what I have termed "natural fertilizers"—that is, fertilizers found in nature and not manufactured; thirdly, on fodders and substances relating to cattle foods; and fourthly, on miscellaneous analyses and experiments.

Virgin soils, districts from which sent for analysis.

First, as to soils: Since the time that I had the honour of addressing the Committee a considerable amount of analytical work, which is necessarily of a protracted character, has been done upon soils, for the different provinces. It is of very great importance, at least, in my opinion, that every farmer should know somewhat of the fertility of his soil, and its mechanical condition. Without such a knowledge, which is enhanced very materially by chemical analysis, it is next to impossible to raise paying crops. We are unable, through lack of time, to analyse all the samples of soil that may be sent by farmers—and indeed such an expenditure of time would not be justiable in all instances, but considerable attention has been given to the analysis and reporting upon samples of virgin soils selected in different provinces. Certain soils have come from the North-West Territories. We have had two samples from the Maple Creek district, and found them to be very fertile and rich in nitrogen. Nitrogen, I may remark, is one of the essential constituents of plant food—nitrogen, potash and phosphoric acid being the three essential elements. The analytical details of these soils, are to be found in the report of the Experimental Farms. I would also draw your attention to several samples that were sent from Walsh Flats, Vermilion Hills and from Tilley, by Mr. Hamilton, Land Commissioner of the Canadian Pacific Railway at Winnipeg. The settlers on these soils were able to raise only very poor crops, and they thought this might be due to the presence of free alkali or deleterious substances in the soil, or the absence of some of the essential constitutents of plant food. Upon analysis these turned out to be very fertile soils, and after enquiring into the matter I found that these districts enjoyed but a very limited rainfall. Therefore, I attributed the very poor crops to the very limited amount of rain rather than to the poverty of the soil. This illustrates one value of the analysis of soils.

Soils have also been analysed from the Proence of Quebec, one of which was obtained from the district of Témiscamingue. This sample was collected by Dr. Robert Bell, of the Geological Survey, who reported that although the soil was very white the vegitation was very green. I analysed the soil and found it was very poor in nitrogen as compared with North-West soil. It contained sufficient of this element, however, to raise good crops, as reported by Dr. Bell. It was a clay loam, and fairly rich in potash. This analysis was of importance, because, as you are aware, there is a colonization society which is taking people to Lake Témiscamingue, and these facts would be of value to their consideration.

Samples of soil from the Sackville Marsh, New Brunswick, have also been analysed to ascertain the character of the soil of that dis-

trict. The two samples analysed were found to contain less fertilizing material than the North-West soils examined. I might mention that the North-West soils I have had the pleasure of analysing have been found to be especially rich in nitrogen, and I believe that that is the reason why we have such luxuriant crops of cereals in that part of Canada. These soils from the Sackville marsh were not poor, but in comparing them we find that the percentage of nitrogen they contain only equals that found in the poorest of the North-West soils. In reporting on these, I recommended the application of wood ashes and marl, or lime in some condition, to improve them.

The matter of soil analysis I take to be of great importance from an immigration point of view, because I think we should have data with regard to the composition of Canadian virgin soils—soils representing, as far as possible, large districts in various parts of the Dominion—for use, not only among our own people, but also for use in England and other places where emigration literature is distributed. People are now becoming more intelligent and better able to understand and to interpret reports made by chemist's especially when they are written in plain English, avoiding the use, as far as possible, of technical terms. It is for these reasons, therefore, that I have devoted a great deal of time this year to the matter of analysis of virgin soils. As an instance of the interest that is being manifested in this work, Mr. Wilgress, a barrister at Huntsville, who is much interested in the Muskoka district, and is very watchful over its welfare, asked me to give him instructions for collecting samples of soils throughout Muskoka, and there are now being collected under his supervision samples of the virgin soil—that is to say, soiled untouched, unmanured or untilled—which will be analysed at the Farm laboratory. From these we hope to obtain an idea of the relative richness of the soils of different districts in Muskoka. We are also devoting some time this year to the analysis of alkaline soils. This work is in progress, and I cannot therefore report finally on it. I may say, however, this: That although I have analysed several of these soils I have yet to find the presence of free alkali, save in very small quantities in a few instances. This is rather curious, and I do not want to speak too definitely upon it; but I am inclined to think that the cause of the poor crop is rather due to something else—I will not say what, at present—rather than to the presence of alkali. The cause may be due in some instances to the presence in excess of salts magnesium.

I have also received for analysis a sample of soil from the Fraser River district of British Columbia—from the delta of the Fraser River. It is an extremly rich soil, and accounts for the very luxurious growth there. I think there are about 30 square miles of soil that have been brought down by the river and deposited at its mouth.

As my time is limited this morning, I must now pass on to the second division, having outlined what we have done, what we propose to do, and the value of these different soil analyses. Our efforts so far have enabled us to suggest measures for the ameleoration of the condition, and advise as to kind of crops and nature of fertilizer for those soils already analysed. We have been able to depict the natural fertility of many Canadian soils, and we wish to go on with this work—to ascertain the relative value for agricultural purposes of the virgin soils of different districts of the Dominion.

By Mr. Trow:

Q. Are not the alluvial deposits in all rivers equally fertile? In the Red River for instance, would not such be equal to the Fraser River?—A. I do not think they would be equally fertile. The soil brought down by a river would vary according to the character of the country through which the river passed.

Natural fertilizers.

Under the second heading that I chose, viz., "Natural Fertilizers," I include what are termed muds, mucks and peats. As you are doubtless all aware, in Prince Edward Island the river muds and swamp muds are largely used as fertilizers. It has not been the custom in that province to keep cattle in sufficient numbers to make manure enough to keep up the fertility of the soil. They have had consequently to fall back upon these muds, and it is therefore of

Swamp muds.

importance for them to know their relative value, as there are comparatively a large number of these deposits from which they can obtain those materials. Many farmers of the island have therefore sent samples to the Farm to know of what value they may be. Now, the chief benefit of these muds to the soil, lies in the amount of nitrogen they contain. They are essentially nitrogenous fertilizers. The nitrogen, existing in the organic matter, has been determined in each case and the relative value of the muds ascertained and reported upon.

By Mr. Trow:

Q. Is it not owing to dead oysters?—A. Those are not of a nitrogenous character—at least, oyster-muds are not chiefly of value for the nitrogen they contain. The oyster and mussel-muds are useful where the soil is deficient in lime, or where lime is required for liberating other constituents in the soil.

By Mr. Macdonald (P.E.I.):

Q. You referred especially to the swamp-muds?—A. To go more particularly into the subject of these muds, I would say the character of the mud depends upon its origin. We have the swamp-muds, river-muds, marsh-muds and mussel-muds of Nova Scotia and New Brunswick, and the black mucks of Ontario, which are really nothing but swamp mucks, and finally peat. There is no strong line of demarkation—except in the case of mussel-muds—in their composition. They run one into another, but they may be differentiated according to their origin. The farmers of Prince Edward Island have taken a very intelligent interest in this work. They send me a large number of samples for analysis, and I am often obliged to curtail the work of the other provinces in order to meet their requirements. We have now many samples which I have not yet had time to examine. As these agriculturists are, however, very anxious, and seemingly willing to benefit themselves as much as they can by the Experimental Farm, we are glad to do what we can

Muck.

for them as time permits. I have been advising them as to the best use of these muds. I do not consider it good practice in the majority of instances to put them on the soil as they are, but first to make a compost. The nitrogen in mucks exists in a condition which is not easily assimilable by plants, but after the process of fermentation or composting the nitrogen is converted into a form more easily taken up by plants. Farm-yard manure, wood ashes and lime are the three most useful materials for composting with these fertilizers. I have also strongly advised the use of many of these mucks, when they are in proper condition, as absorbents to be used in stables, cow-houses, and the like. This advice will be useful in other parts of Canada wherever mucks are to be found.

Peat.

Peat is especially beneficial for this purpose. A large portion of

the liquid manure is often lost unless there is a complete drainage system in stable and cow-houses, or absorbents are used. The liquid portion of the manure is more valuable than the solid, and should not be allowed to go to waste. By the use of these peats, which can be obtained in many places without much outlay to the farmers, this waste is prevented. These peats absorb the liquids and the gasses, and keep the atmosphere of the stable and cow-houses pure, while at the same time they make valuable manure. Not only do they hold the valuable constituents of manure, but they themselves are, by the fermenting process, rendered more valuable because the nitrogen in them is rendered more soluble.

By Mr. O'Brien:

Sawdust. Q. What result is obtained from using fine sawdust as an absorbent in the stables?—A. Fine sawdust is extremely undecayable. The turpentine and resin in it prevent it from readily fermenting. There is not much nitrogen in sawdust.

Q. I mean merely as an absorbent. I found in my stable, when I used fine sawdust, there was not the slightest effluvia, but when mixed with the barn-yard manure would it be available again?—A. Yes; you would get all the fertilizing elements in the liquid manure, but the sawdust itself would not be of much value, because there is little nitrogen in it, but fermenting with the liquid manure it would be rendered more valuable. Dry sawdust would no doubt act as a splendid absorbent. Again, another absorbant frequently used there is gypsum, also often applied as a fertilizer by itself. In stables it fixes the ammonia in the liquid portions of the manure, and consequently you have a more or less concentrated fertilizer as the result.

By Mr. McMillan:

Straw. Q. Do you think cut straw would be better than sawdust?—A. Yes; cut straw would contain more plant food than sawdust, and it would be more easily rotted. Cut straw is often recommended for this purpose.

Marl. To continue the subject of useful fertilizers, I might mention that samples of marl have been analysed from different parts of the Dominion. The use of marl is principally recommended for the lime it contains. Samples have been analysed containing over 90 per cent. of carbonate of lime. Its application greatly improves the tilth of many soils—both heavy clay, peaty and sandy soils; but unless the soil is deficient in lime we do not put great value upon the fertilizing power of marl. Experience has shown that it is useful on light sandy soils, because it helps to render them heavier and more retentive of moisture and fertilizing material. At the same time it converts the nitrogen into forms that can be easily taken up as food by plants. It promotes nitrification, and thus hastens the decomposition of the nitrogen—holding organic matter of the soil, which latter process must proceed if the fertility of the soil is to be utilized to the fullest extent. Nitrification is the result of the growth of bacteria, and is greatly encouraged by the carbonate of lime in marl.

Q. Would you consider pine sawdust a very good thing to place upon heavy soil?—A. Yes sometimes; because of its mechanical condition—just as I would advise sand to be placed on some soils to improve their tilth.

Wood ashes. Before leaving the subject, I wish to speak a moment upon wood ashes. We have analysed some samples which show that Canadian wood ashes are very valuable as fertilizers from the amount of

potash they contain, in the first place, and in the second place from the amount of phosphoric acid they possess. They vary from 4 to 9 per cent. of potash, usually about 8 per cent., and about 2 per cent. of phosphoric acid.

By Mr. Davin:

Q. How much nitrogen?—A. No nitrogen. The lime in them is, however, of some agricultural value.

Waste of natural fertility, by fire, in clearing the land.

Q. Have you ever been asked what was the value or the reverse of value of prairie fires in the North-West—burning the logs and vegetation?—A. I may say a few words about that. I have been up through Muskoka for a few days, and have been looking into the matter of fires, their value and result. I came to the conclusion that the method of clearing land at present adopted is a very wasteful and unprofitable one. There was one gentleman there who was quite positive that the rocks grew. I saw that however chimerical might be his theory, he was quite right in his observation. In places there the soil is so rich in humus that you can set fire to it and it will burn like tinder. What is left is really sand, with very little else; whereas, before the fire destroyed its other qualities, it was very rich in plant food. After a fire the rains wash this sand from the rocks, which, as the farmer there said, seemed to grow. I think it is well that the farmers should know that they are burning up the fertility of the soil and that that soil will not be replaced for many years—many generations. More care needs to be taken in clearing land by fire, lest more harm should be done than good.

Q. That is to say, they burn up the soil with the logs?—A. Yes; they burn up the whole thing. This waste, I think, could be prevented in a large measure. The material from the woods might be collected in heaps, and the fire, as far as possible, restricted to those heaps and kept from spreading. I have never visited the North-West, and could not speak from experience as to the reverse to the soil of prairie fires.

By Mr. Trow:

Q. I would ask you if you had a farm with a few sand hills, and containing a few acres of land with some peat moss or earth deposits at the other end of the farm, which would you prefer—barn-yard manure or those deposits to put on the sand hills or gravel ridges?—A. I should be inclined to put on some of both. From the alluvial deposits you would not get an immediate return. You would improve the tilth of the soil and get some return, but it would be a slow one. The action of the atmosphere and of the rains would be gradually rendering the soil more and more fertile, but you would not get the immediate result that you would get from barn-yard manure, though if you used barn-yard manure alone in sufficient quantities to perfect the mechanical condition of the soil, I venture to say that you would have too strong a soil, and one also which leached and wasted its fertility easily through excessive drainage. You would not have that condition of tilth which would be in the highest degree beneficial to most forms of crops at the least cost by the use of barn-yard manure alone. Such a sandy or gravelly soil would require mineral fertilizers as well, which would not be supplied in any quantities by the application of either black muck or born-yard manure. The addition of marl and wood ashes would be advantageous.

By Mr. McMillan:

Q. You spoke of the farmers adopting some other system of clearing their land. What system would you adopt?—A. I have

no system to recommend. What I should like to emphasize is the necessity of using very great care. The greatest possible precaution should be exercised to see that the fires do not spread. I know in many instances that such care has not been taken. The soil, left with only its mineral constituents, (phosphoric acid and potash), is of little value. It is the nitrogen that is destroyed by fire, and its presence is absolutely necessary in a soil for farm crops.

By Mr. Ferguson (Renfrew):

Q. Is there any fertilizing value in coal ashes ?—A. No; at least, it is so infinitely small that coal ashes are practically valueless, as a fertilizer. They, however, benefit clay soils by improving their tilth.

By Mr. McGregor:

Q. Are leached ashes of any value ?—A. That depends upon the extent to which they have been leached. If they are thoroughly leached they are only valuable for the lime they contain and about 1 per cent. of potash, besides some phosphoric acid.

By Mr. McDonald:

Q. I suppose pine ashes would have the same value as other woods ?—A. No; not necessarily. The ashes of different woods vary in their composition. Pine ashes are said to contain a smaller percentage of potash than those of some other forest trees.

Q. Would they have about the same effect ?—A. No; not unless they contained an equal amount of potash. The ashes analysed were from a large number of woods—maple, beech, &c.—all hardwoods, I believe.

Q. Is it not very dependent on the degree of heat to which the wood is subjected as to the amount of fertilizing material that would be retained ?—A. You mean as to the volatilization. I believe you can volatize it, but I doubt very much if you could do so in the ordinary furnace in which ashes are produced.

Q. But in any furnace ?—A. Oh, yes, such is possible. I have a furnace at the laboratory that would volatize ashes to some extent.

Q. I am familar with the question of sawdust and ashes. We have had some experience in using sawdust for bedding purposes and then using it on the soil. We found that in using sawdust that had been employed as a bedding for cattle that it would destroy vegetation altogether ?—A. I do not know what that may be due to. It might be due to the sawdust, or you might have made it too rich. Of course, it takes a certain time for decomposition to take place and if you put the sawdust on too thick you have got too much wood, which would choke vegetation.

Q. My experience is, that the degree of heat is tremendous in our furnaces, and yet our pine ashes have been found to be very valuable as a fertilizer ?—A. I have no doubt. I wanted to say that we have not yet any data as to the composition of pure ashes from different woods. I hope some time to be able to take the Canadian woods and analyze their ashes, and thus obtain the relative value of ashes from the different woods of the country. My chief object in bringing this matter up is, that by the publication of this evidence the Canadian farmer and horticulturist may be led to enquire into and experiment upon the value of the wood ashes produced in this country as a fertilizer. It seems remarkable that Canadian ashes can be sold in the Eastern States for three times the price that they can be sold for in this country. There is very little demand here, yet they are eagerly snatched up in Massachusetts by the farmers.

By Mr. Trow:

Q. You have received soil from the various parts of the Dominion?—A. Yes; our object was to ascertain the quality and value of the soil in those districts from which they were obtained.

Q. Did you get a statement from the parties?—A. Yes; we were careful to get very particular statements. We got samples of the surface and the sub-soil. We learned the character of the woods grown on that soil, and all other particulars relating to the soil sent. Before analysis we ascertain, as far as possible, that the samples to be examined are thoroughly representative.

Q. Otherwise you would have no criterion, because in Muskoka you would get the washing for centuries—the washings of the fertile soils of the mountains down into the valleys. A pot full of that soil would be different from the soil around it?—A. Full particulars are published with the analysis as to the character and history of every soil examined.

By Mr. McMillan:

Q. You spoke of the soil from Quebec having little nitrogen in it, and yet it seemed to be fertile. I suppose the difference was that the nitrogen was in a soluble state?—A. I was speaking only of the white soil from Lake Témiscamingue. I have no doubt that there are some soils in Quebec quite as rich in nitrogen as those in the North-West, but I wanted to point out that the sample which had been analysed from this particular district—and I took care to name the district—did not equal in this respect the soils that had been sent from the North-West. The soils that have been obtained from the North-West are particularly rich in nitrogen. That is a noticeable feature of them.

Q. Can you tell the amount of plant food in each sample of soil that is available, or can you only tell the quantity that is there, perhaps some of it locked up?—A. I will explain that as far as I can: Chemical analysis will tell us the total amount of plant food in the soil but cannot tell the exact amount that is available for immediate use. We can ascertain by analysis whether any element is there in excess or whether it is lacking. We can tell the amount of nitrogen that is available as a whole; but as to the length of time within which it would be available we cannot say. The same is true of any other food constituent for plants. If it is not there we cannot make it available, but if it is we can render it available. Rains and the atmosphere are continually doing this useful work, but it can be hastened by artificial means.

Fodders.

I now come to my third division, namely, fodders. The chief work that has been done in this division has been in the analyses of grasses. At the Central Experimental Farm, under the supervision of Mr. Fletcher, a large number of native Canadian grasses are grown. Last summer I analysed 52 samples of these native grasses. Many of these varieties were taken at two stages of their growth in order to ascertain the right time for cutting them for preservation as hay. The results of the analyses also show their relative nutritive value. The work has been tabulated, but it has not been published, because I have some forty yet to analyse, which have been prepared under certain conditions and are awaiting further treatment. To complete this work, grasses have also been collected at our Experimental Farms at Brandon and Indian Head, respectively, from the analysis of which we hope to ascertain whether there is any difference in the composition in the grasses grown at either of these points, due either to soil or climatic influences—that is, whether there is any difference in their value as cattle food. This series

of experiments is being undertaken because we have understood that cattle on the plains fatten much quicker than here, and it may be due to the greater nutritive character of the grasses.

There is one point which has been elucidated in connection with these grasses, and that is with regard to the time of cutting them. As I say, we have 52 analyses completed, and many of them show the composition of the same grasses in different stages of their growth. We have found that when the grasses have been allowed to ripen fully there has been a great loss of albuminoids. The albuminoids are the part of the fodder which constitute its chief nutritive value, the flesh-forming part. By allowing a grass to pass the flowering stage there is a loss in these albuminoids, and consequently the grass depreciates in value as food. At the same time, a great deal of the fibre of the fodder becomes hard and indigestible, and therefore I can clearly point out, as the result of analyses, that it becomes advisable to cut the grass—perhaps not all grasses, but the majority of them—while they are flowering or before the seed has fully formed. I have brought a table with me of these analyses, and I will make one or two extracts, to illustrate what I have said. The Committee will understand that the albuminoids are the most valuable constituents of the food; next are the fats; then in order the carbo-hydrates, and finally, or the least valuable, the fibre. Now if we take timothy when it is just spearing we find it contains 17 per cent. of albuminoids, but after the seed has ripened it contains only 8 per cent. We have here a very large diminution in the amount of albuminoids. In June grass the albuminoids are 18 per cent. while in flower, but they have decreased to 10 per cent. when the seed is ripe.

Chemical changes in grasses, in course of development.

By Mr. Fairbairn:

Q. Will you tell us about the red clover?—A. My table applies to grasses only. I have not as yet analysed any clovers.

By Mr. Trow:

Q. What becomes of that diminution?—A. It is lost, to a very great extent. There is a migration, as the plant matures, of the albuminoids in the stem and of the leaf to the seed, and then if the seed ripens and falls you have lost a great part of the nourishment the grass contained.

By Mr. O'Brien:

Q. Did you ever see experiments with the brown grasses? The result was to show that the timothy was more valuable with the seed in it, after the seed had ripened than before?—A. If the seed is left in the plants.

Q. Yes.—A. I do not know that you can preserve it with all the seed in it. There have been some careful experiments made to test this. We have made experiments ourselves in this direction, and we have discovered that a great amount of the albuminoids has been lost by allowing the grass to proceed to maturity.

By Mr. Trow:

Q. Would you recommend the cutting of timothy when it is first blooming?—A. About the right time would be when it is in bloom. The growth of different grasses varies much, but still it is well marked throughout that as the seed is formed and ripens there is a diminution of the total amount of albuminoids in the plant.

By Mr. Rowand:

Q. Does timothy bloom more than once?—A. I cannot answer that positively, but I think not. Do you mean on the same stalk?

Q. Yes; when it comes in bloom first.—A. I think Mr. Craig would be better able to answer that question.

Mr. Craig.—I think there is what is commonly called among farmers the second bloom of timothy. I examined a number of heads with Mr. Fletcher this season. First of all, there comes a pinkish colour, and then after the pollen has been shed this fades away and is followed by the lighter colour, which is called the second bloom. Without having examining the matter very closely, this seems to be the reason for speaking of the second bloom of timothy.

Mr. Trow.—There is evidently a change in the colour of the bloom in a few days.

Mr. Craig.—In the spike of flowers some may bloom at different periods. In a spike of timothy it is the one at the top which blooms last, and the one at the bottom may be one or two days earlier.

By Mr. Gordon:

Q. Have you made any experiments in regard to the bunch grass of British Columbia?—A. Not yet. There are so many so called bunch grasses that I do not know exactly which your question refers to. Is it peculiar to British Columbia?

Q. Yes.—A. I have not analysed any British Columbian grasses as yet.

Indian corn, constituents of at different stages of growth.

Now I come to the next subject, which is Indian Corn. In Bulletin No. 12, the results of the analyses made in our laboratories, of Indian corn grown on the Farm will be found tabulated. Indian corn, as you are aware, has become the fodder plant of this country, especially since the silo has been introduced. The first result of our work was, that we found as the corn plant matured there was a very large increase of a dry matter in the plant. The water in corn generally runs from 75 to 80 per cent., and is of no value. The value of the corn plant as a fodder chiefly consists in the amount of the dry organic matter which it contains, and secondarily in the composition of that dry matter—that is to say, the extent to which albuminoids, fats and carbo-hydrates occur. The plants which we experimented on were of different varieties and were cut at two stages of their growth. We found, that it would be more advantageous to allow the corn plant to mature, that is to say, to come to the glazing stage, before cutting for the silo, than to cut it at a period previous to that time. That is the chief result which has been brought out by our experiments and analyses and there is ample data to support the advice here given. We are following up that line of experiments this year, and in connection with the Dairy Commissioner we are experimenting with four varieties—Longfellow, Pearce's Prolific, Red Cob Ensilage and Thoroughbred White Flint. These experiments consist in growing the plants in rows 3 feet apart. We shall take 100 feet of two rows at five stages of growth from a part of the field which represents, as near as possible, a fair average of the whole. The weight will be recorded and the composition ascertained. From that we shall be able to deduce the value of the the corn crop at different stages of its growth in these varieties, and show the gain or increase in weight per acre at the different stages. This will of course be of very great value to those growing corn for fodder purposes, as it will enable them to know what are the best varieties—those varieties which give the greatest yield per acre—and also the time at which the largest amount of dry matter is present.

By Dr. Roome:

Q. Would climatic influence have any effect on the nutritive qualities of this plant?—A. The analyses of last year show that the variation in composition between the varieties is exexceedingly small. The difference are principally in the weight or the yield per

acre and the amount of dry maiter. We are endeavouring to ascertain the variety of ensilage corn which will produce the greatest amount of solid matter the largest yield per acre, and to learn the best method of growing it.

By Mr. Trow.

Q. Regardless of its feeding properities?—A. Yes; because, as I say, the analyses show the composition of these corns is exceedingly close, and therefore it is advantageous to grow a corn which will come to maturity and give a heavy yield per acre.

Following up the analyses of varieties of Indian corn as fodder, we have also analysed the ensilage produced from them, and as a deduction from our last year's work, I may say that, between the ensilage and the corn which produced it, chemical data show but little difference in the feeding value. Our last annual report also contains analyses of linseed meal, germ meal and cotton-seed cake used on the Farm, which will be found of value to stock feeders.

Sugar beets grown in Canada,—analysis of.

I may now refer briefly to sugar beets, a considerable quantity of which have been grown and examined during the past two years. Most of the sugar beets that have been examined at the laboratory were grown from seed imported from Germany by Mr. Wilfred Skaife, of Montreal, at his own expense. The seeds was distributed amongst the farmers of Ontario by Mr. R. H. Lauder, of Toronto, who collected the roots and forwarded them for analysis to our laboratory. We received very few samples during the first year, but two years ago we analysed 25 samples, and the average quantity of sugar in the juice was 14¼ per cent. Last year, 1890, 68 samples were sent to us, selected by Mr. Lauder in the same way from seed supplied by Mr. Skaife. The results were lower, the average being 12½ per cent. sugar in the juice. I do not know whether this diminished sugar content was due to the season, the defective preparation of the ground or the seed. This year we shall continue the work and make further tests in culture and sugar-content of beets grown on the Experimental Farm and elsewhere. It is most essential that the beets receive a thorough cultivation during the earlier stages of growth, and the root be kept covered as it matures. Sugar beets have been grown in France that contain a very high percentage of sugar. The Vilmorins, of Paris, have produced varieties of sugar beets containing over 20 per cent. of sugar, and I believe it is possible to grow beets in many parts of this country containing 17 per cent. of sugar. We have analysed a number of samples containing over this amount. I have no hesitation in saying, that in many parts of the Dominion, sugar beets can be grown containing sufficient sugar to make its extraction profitable.

Q. At the present price of sugar?—A. I am not speaking with regard to the price of sugar in the market, nor of the price of the labour necessary for the cultivation of the beet; but I state that it is my belief that beets can be grown containing sufficient sugar to make the extraction of the latter profitable, provided the other factors are favourable.

By Mr. Bain:

Q. How did the low grades run—below 12 per cent.?—A. Those were very few. I found that 60 per cent. of the samples yielded over 12 per cent. of sugar, and 38 per cent. of the samples yielded over 13 per cent.

By Mr. Bain:

Q. Where were the low grades grown?—A. There were very few that ran below 12 per cent. I should have to refer to my report for 1890 to ascertain the exact localities in which they were grown.

By Mr. McMillan:

Q. Did you ascertain, with respect to the preservation, whether those that were the best in sugar-content, were the best cultivated? —A. Yes; as far as I was able with the particulars at my command. The yield of sugar in the beet depends largely upon the cultivation it receives and the quality and variety of the seed. Then, again, the soil is an important factor in the successful cultivation of the sugar beet. You cannot get good roots containing a proper quality of sugar and a high coefficient of purity without the right kind of soil—that is, a suitable soil, in a good mechanical condition. By "coefficient of purity" I mean the percentage of sugar in the total solid matter of the juice. The profitable extraction of the sugar does not entirely depend upon the actual percentage of sugar. For example, let us take two samples, one containing 12 per cent. and another 14 per cent. It might be more expensive to extract the sugar from the latter than from the former, owing to the root possessing a lower coefficient of purity than the beet with 12 per cent. of sugar. If the roots are not properly grown, certain albuminoid substances are developed in the beet which make it difficult for the sugar manufacturers to separate the sugar from the juice. It is advisable, therefore, that those about to grow sugar beets should first acquaint themselves with the proper methods of cultivation, the soils most suitable, and the best varieties to grow. By so doing a great measure of success may be ensured. In many instances failure has resulted from treating the sugar beet like any ordinary root crop. I cannot, as my time is running to a close, speak more exhaustively on this matter, but you will find, in my annual report of last year, directions, in a condensed form, necessary for the successful cultivation of the sugar beet.

By Mr. Trow:

Q. Have you made any inquiry as to the cost of the machinery necessary for refining? I am told that it is very expensive—that it costs thousands of dollars?—A. Yes, it does; but that inquiry does not come within my province. I consider that it would be advisable for the Government to take into their earnest consideration the advisability of appointing a commission that could inquire into the whole matter of the growth of the beets and the production of sugar. The commission should consist of practical men and experts who would consider it from a practical and financial point of view, and some scientific men who would do the chemical part of the work. To make the proper deductions it is necessary to know accurately all the factors of growth, and these are not always obtainable from the average farmer. By a right choice of seed and soil, by a correct application of proper fertilizers, by a thorough cultivation and careful harvesting, and the analysis of the product, valuable data would be obtained as to the desirability of this industry for Canada. The cost of labour and the price of sugar will undoubtedly be serious considerations in working out this question. An important matter in the management of the crop that I forgot to allude to is, that the beets should be grown so close to one another in the row that they do not exceed 1 lb. to 2 lbs. in weight, and that the rows should be 18 inches apart. By these means a richer juice is obtained and the larger number of roots per acre compensates for their small size.

Q. The richest beet is in the form of a carrot?—A. Yes; but you find the shape differs somewhat according to the variety, and there are a great many varieties. The whole matter is one of great importance, and as yet nothing has been done towards the systematic and scientific threshing out of it. I have not touched upon

what I may call the secondary advantages of sugar beet culture, including the improvement of the soil and the value of the pulp from the mill as a fodder for milch cattle. Allusion to them will be found in the report I have already referred to.

Milking stocks
Quality of milk from different breeds.

With regard to milk: In the report for 1890 will be found the composition of the milk of the different breeds that are kept at the Central Experimental Farm—Shorthorns, Jerseys, Holsteins, Ayrshires, Polled Augus, and Grades. We did this work in order to obtain, if possible, standards of richness for the milks of the different breeds, for future reference. We found, as a result, that there is a great deal of variation in the quality of the milk between the individuals of each breed. Although the Jerseys stand at the head of the list as giving on an average the richest milk, yet we have found individuals of other breeds exceding in the quality of their milk cows of this noted dairy breed. Cows of the same breed vary greatly in regard to the percentage of fat in their milk; and at short intervals, we find the quality of the milk of the same cow varies.

By Mr. Davin:

Q. The quality in the same animal?—A. Yes. What I mean to say is this: That I found very frequently greater difference between two individuals of the same breed than I found between individuals of two different breeds. The breeds have their special characteristics; yet there are individual characteristics in some cows which are strong enough to overcome them to a great extent.

By Mr. McMillan:

Q. Have you observed, under the same treatment, whether a whole herd varies in the richness of the milk, or is it only in individual animals?—A. I have no data from which to draw any conclusions as to that matter. Not only the quantity, but the quality of the milk depends on the food, the individual characteristics of the cow the time she has calved, the period in calf, and her nervous temperament.

By Dr. Ferguson (Leeds and Grenville):

Q. What influence do the powers of digestion have on the milk?—A. The cow with the greatest digestion will give the most milk, if she be of a dairy breed.

By Dr. Roome:

Q. But it does not increase the quality of the milk?—A. No; not necessarily.

By Mr. McMillan:

Q. Do you consider this improved quality of the food will have an immediate effect on the quality of the milk—say, within a week or so?—A. I think so—within a week.

By Dr. Roome:

Q. You think a cow kept in good condition will give a better quality of milk than one which is not?—A. Undoubtedly.

Methods of testing the value of milk.

I wish to bring before you some further work done in regard to a method for quickly and readily ascertaining the quantity of fat in milk. As most of you, gentlemen, are aware, milk is purchased in the creameries and cheese factories by weight, which, not being relative to the fat it contains, does not gives a criterion as to its value. The value of milk depends on the amount of solid constituents it contains, chief among which is the butter fat. While we can, with a great deal of accuracy, determine the percentage of fat in the laboratory, it has been difficult until now for the dairymen and cheese-makers to ascertain the richness of milk. Dr. Babcock, of Wisconsin, has devised a method which enables any intelligent

man, after short practice, to readily ascertain the value of milk by giving him the percentage of fat it contains. It will be possible in the future, after the system has become thoroughly known, to introduce a scale by which milk may be bought and sold according to the richness in fat and solid constituents. By this system, a man bringing milk to a factory containing 5 per cent. of fat will obtain more per pound than the man bringing milk containing 2½ per cent. At the present time, the lactometer and similar instruments are used; they serve to demonstrate whether the milk has been grossly adulterated or not, but the results are often fallacious, and, as a rule, they are unsatisfactory to both buyer and seller. The variations in the qualities of genuine milk are not recorded by these instruments. When the Babcock method has been introduced throughout the country (the Dairy Commissioner has supplied his instructors with them, who are explaining their use and value),—and when the people have gained faith in the test, which, I think, will not take long, there will be a far better system for buying and selling milk than at present in vogue. If by the present system fraud is not encouraged, at any rate it is not always found out, and the man who keeps scrub cows and does not feed them well gets the same price for his milk as the man that keeps good cattle, feeds them well, and supplies a rich milk to the creameries and factories. By the Babcock test reliable results can be obtained. Our laboratory experiments published in Bulletin 4, of the Dairy Series, show that the Babcock results are within ¼ of 1 per cent. of the truth, so that this method may be looked upon as reliable and accurate. By its introduction the farmers will be encouraged to keep better cows and to feed them better, and there will fail to be any object for a man to adulterate his milk with water, because such would simply mean that he will team the water to the factory at his own expense. If the milk is found to contain 2 per cent. of fat the farmer will be paid according to that quantity of fat; if it gives a greater percentage of this constituent he will be paid accordingly.

By Mr. O'Brien:

Q. Professor Robertson told us the complete opposite of what you have said in regard to the qualities of the food. He told us that the quality of the food made no difference in the quality of the milk, until after the constitution of the cow had been entirely changed.—A. I am sorry that I did not hear Professor Robertson; I should regret to contradict so eminent an authority. Did he say as to what length of time?

Q. Not less than a year.—A. The data I have had reference to do not point to that conclusion. However, I do not propose to set myself up as an authority on this question, especially against Professor Robertson; and further, I should greatly like to see what he said before criticizing his evidence. I advise you to accept what he says, but I am of a different opinion.

By Mr. McMillan:

Q. I am of your opinion, Mr. Shutt, but I think that is one point on which you can make very interesting experiments at the Central Farm?—A. My authority is German, principally. I said that our own experiments did not give us sufficient date to draw conclusions from. I spoke on very good authority, but the facts were not obtained on our own farm. Personally, I have been of that opinion. I believe in much less time than a week the quality of the milk of many cows would be materially richer by improved feeding, but in order to be on the safe side I put it at that period. I will now direct the

attention of the Committee to another branch of the work which is of considerable interest.

Preventive remedies for smut in wheat.

As a preventative remedy for smut in the North-West, a solution of copper sulphate or bluestone is recommended and largely used for treating the seed wheat. This is done for the purpose of killing the germs of the hard smut or bunt. Two years ago we received from Winnipeg a sample of bluestone which contained sulphate of iron as well as sulphate of copper, with a request that it be analysed. It was sold under the name of "agricultural bluestone." The price of it was much lower than pure sulphate of copper, and it was thought that if it were as efficacious for the treatment of smut as the sulphate of copper, its introduction and use would be a great boon to the farmer. I first instituted experiments at the Farm here to ascertain what effect solutions of sulphate of iron and sulphate of copper had upon the germinating power of the seed. Following up these experiments, I found that while under certain conditions the sulphate of iron had very little effect upon the germ of the seed, the sulphate of copper under certain conditions had a deleterious effect. I repeated this experiment once or twice in order to make quite certain of the result. I thought it would be well to pursue the experiments further, in order to ascertain if the sulphate of iron was as effective as the sulphate of copper for the prevention of smut, because, if so, there would be less loss in the vitality of the wheat so treated than in that treated in the usual manner. This form of smut rarely develops here, so I am continuing these experiments this year at Brandon and Indian Head, where, of course, the smut is often prevalent. I am experimenting on seed treated with sulphate of iron, seed treated with sulphate of copper and seed treated with a mixture of the two, comparing them with the same varities sown without treatment; by these experiments we shall find out to what extent the smut has been diminished by the various forms of treatment. This, I consider, is an important problem in the North-West, on the solution of which some time may be very well spent

By Mr. Watson:

Various solutions and their properties.

Q. What quantity would you use to the bushel?—A. The solution we made had the strength of 1 pound to the 8 gallons. I soaked the seed for 46 hours in this solution, and then ascertained its vitality. In the case of sulphate of copper I found that its vitality had been greatly lowered. In the case of sulphate of iron but little or no injury had been done to the germ of the wheat. In the case of agricultural bluestone the figures were half-way between the two. For instance, the percentage of vitality in the untreated seed was 97·5 and that treated with agricultural bluestone, 64. The percentage of vitality in that treated with sulphate of copper alone was 40. I thought that this treatment was rather severe, and I proceeded to ascertain what the effect on the wheat germ would be by simply sprinkling the seed with the solution. I found that when using a solution of sulphate of iron the vitality was not affected at all. With regard to "agricultural bluestone." I found the percentage to be 79·5 and with sulphate of copper 72·5; these were the results as far as they went last year. The experiment is being continued this year. Owing to no smut being developed on the plots here last year, I cannot say as to the value of these solutions for destroying it—that is, I can give no opinion regarding the relative efficacy of sulphate of iron and sulphate of copper for this purpose.

By Mr. Trow:

Q. What effect would dry ashes sprinkled upon the grain on the barn floor have as against smut?—A. It has been recommended,

but I have no data with respect to it. Sulphate of copper is a very old and very reliable remedy. What we wanted to ascertain was whether sulphate of iron, which is a cheaper article, would answer as well or better. My experiments have pointed to the fact that sulphate of copper is injurious to the germ of the wheat if allowed to remain in contact with the grain, and therefore, if sulphate of iron is as efficacious, it would be better to use it.

By Mr. McMillan:

Q. Have you tried the effect of salt brine ?—A. It has been tried at the farm, but I have no data with me. They have also tried boiling water, and allowing the seed to remain in contact with water at different temperatures for greater or longer periods; but I have not the data with me.

By Mr. Roome:

Q. Have you ever tried the sulphate of soda ?—A. I have not tried it. It might have an injurious effect on the vitality of the wheat or it might not.

Q. It has proved efficacious in human subjects, and it might be equally so on vegetable substances. How would it compare with regard to cost—how does the sulphur in it act ?—A. I do not know what the difference would be in the item of expense, nor do I know in what way the sulphur in these compounds becomes the active agent. It is very difficult to say. In sulphate of copper it is not the sulphur which does the work ; it is the whole compound. Sulphate of soda is a germicide, and consequently might be useful for killing the smut.

Q. But it would seem that all these sulphur compounds work pretty much in the same way ?—A. Yes; it seems so. For that reason, gas lime might be an efficacious remedy.

Honey—foundation comb.

To continue, I would refer to what has been done with regard to "foundation comb." A year ago last June we received a communication from the Messrs. Jones, of Beeton, accompanied by samples which they thought were adulterated, although it was sold as pure beeswax. Not only is parafine cheaper than beeswax, but under the influence of the heat of the summer season it melts very easily. This particular "foundation comb" was found to completely break down in the hives during the summer, often causing great loss of brood and honey. By our work in the laboratory we exposed the fraud. In one sample we found 60 per cent. of parafine, and in others 40 and 30 per cent. Our results were published in the *Bee Journal*, and the effect was salutary. No adulterated foundation comb has been found in Canada since. The man who sold the comb said he got it from the States. Subsequently I got a letter from Dr. Wiley, Chief of the Chemical Staff at Washington, who said he was preparing a bulletin on foundation comb. He said he had seen my report, but in all his investigations he had not found a single case of adulteration. I have mentioned this work of ours as being of considerable interest and value to the honey industry.

Well waters.

I spoke somewhat briefly on the subject of well waters when I had the honour of addressing the Committee on the last occasion. We offered to make analyses of well water for farmers free of expense, if they prepaid the express charges, reporting to them as to the wholesomeness of the supply. Although we have hitherto done this, there undoubtedly will come a time when, on account of the vast amount of work, we can no longer do this work free of expense; but in order to awaken the interest of the farmer to the necessity of pure water for himself and stock, we have so far thought well to do it. The importance of wholesome water on the

farm is very great; but water not being a marketable commodity, very little attention seems to have been given to it. I find that wells in many instances have been sunk in the centre of barn-yards, and as a result they act as mere cesspools for gathering the pollution of the neighbourhood. I do not know whether it is because only sick people go to the doctors, but I can assure you that I only get the worst of waters to analyse. Nearly all the waters I have examined are unfit and dangerous to drink. If the waters I receive in the laboratory for analysis are any indication of the quality of the water, generally consumed, I can only say that it is high time most of our people sought a different supply. My time for addressing you, gentlemen, has expired. I have not been able to deal with as many subjects connected with my department as I should have liked to have done, nor have I been able to go at all into detail, but I shall be glad to answer any questions with regard to any of the phases of the work that may be put to me.

By Mr. Ferguson:

Stacked corn as a substitute for ensilage.

Q. There is one question of considerable importance to farmers, especially to smaller farmers. How does the nutrition of corn preserved in racks or stacks compare with that preserved in silos?—A.—We have no data at the Experimental Farm from actual feeding experiments to enable me to answer that question.

Q. Give us your opinion?—A. There is an immense amount of conflicting testimony in regard to the value of dry corn fodder as compared with that of ensilage. There is a loss of albuminoids to some extent in ensilage. These constitute the most nutritious portion of a fodder, as you will remember. Also, there is in the silo a tendency for some of the starch and other carbo-hydrates to be converted into organic compounds of a doubtful food value; so that there is a loss on these two points. But on the other hand, the corn is probably rendered, by the process of fermentation in the silo, more digestible. In the case of dry fodder corn, the fibre becomes to a large extent indigestible. I myself am in favour of *well kept* ensilage. It is a succulent food, greatly relished by the cattle, and, if properly preserved, it is very digestible. A great deal depends upon the manner of preservation. I believe that corn ensilage deteriorates very little if properly packed, and the air thoroughly excluded.

By Mr. Ferguson:

Q. Do you think that corn kept in stocks does not deteriorate very perceptibly?—A. Yes. A part of it becomes indigestible, and indigestible food counts for nothing for the nourishment of cattle.

By Mr. Fairbairn:

The chemistry of tree culture.

Q. Have you had the question of tree culture brought under your attention at all?—A. Yes; and it is one that I deem of great importance. In the relation of chemistry to horticulture, I have done some work—principally in connection with fertilizers for apple orchards. Before the Dominion Fruit Growers' Association, held in Ottawa, February, 1890, I read a paper on the composition of the leaves, the result of analytical research. I took the leaves of five or six varieties of apple trees at different stages of growth, and found out what they extracted from the ground in the way of nutriment, and the amount of these elements. It is of importance to find out what food the trees require, and by analysis we ascertain facts of great value towards this end. The result of that work is given in detail in the report for 1890, and I would like to refer those interested in the subject to that report. In it is clearly shown the amount

of mineral organic matter that the leaves take from the soil. We find that the leaves contain a large amount of potash, and consequently wood ashes would be a very beneficial fertilizer to use in orchards. I propose, as time allows, to make a complete analysis of the different parts of the apple trees—leaves, stem andfruit.

By Mr. Gordon:

Q. How about coal ashes. Are they of any value?—A. No; coal ashes are very good for improving the tilth of the soil, but the amount of their fertilizing constituents is so small that you need hardly take it into consideration.

By Mr. Fairbairn:

Q. In the cultivation of fruit a good deal depends upon the soil. For instance, there are some sections where you can grow peaches successfully, and others where you can grow pears. There are others where you cannot grow pears at all. Is it not possible to devise some means of issuing a bulletin advising farmers how to grow pears?—A. It may be that some of the diseases that have worked so much damage elsewhere have come into the parts you refer to, and are rampant; or it might be that the soil has become to a great extent exhausted of those elements of fertility required by trees, if the trees have been grown a great many years on the same spot. A bulletion could not be issued upon this subject to cover the Dominion at once. It would take us some years to make the necessary observations.

By Mr. McMillan:

Q. With reference to these fodders and the presence of albuminoids, that you referred to before, I suppose there is a period in the growth of the plant when it (the plant) will be more nutritious than others. The riper it is, the poorer will be the straw and the richer the grain; but I suppose there will be a proper time to get most nutrition from the grain and seed?—A. The period would vary for different plants, but in most instances it should be just before it is thoroughly ripened.

Having read the preceding transcript of my evidence, I find it correct.

FRANK T. SHUTT,

Chemist, Dominion Experimental Farms.